Managing the Technical Integrity of a Pipeline with an “Out of the Box” GIS- and Geodata-based PIMS

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The presentation shall introduce a software which makes it possible to establish a pipeline integrity management system. Used will be already existing GIS and expert data which are delivered to the evaluation software. In this case we will focus on the approach and the realisation of the process using Smallworld GIS. The software that is introduced is not bound to one special Geographic Information System. It is platform neutral.

The technical integrity of a pipeline meaning the correct and technically proper state in terms of security requires maintenance and repair because the current state may change dependent on time through third party damage, corrosion etc. The driving goal is that all security relevant processes are examined holistic and organised in a Pipeline Integrity Management System (PIMS). That was the reason for developing the product »trascue.PIMS« in co-operation with a pipeline operator.

The technical integrity can be shown by collecting all essential influences on the system for each pipe segment. All this information will be evaluated using a standardised concept. An analysis of reliability is performed applying the criterion of failure probabilities in the technical condition analysis (TCA). That’s how pipeline operators are able to detect weaknesses of a line or loop and also to take action in order to ensure its proper condition.

Already existing GIS objects and objects from a newly developed database are used for the assessment. The data model is available “out of the box”. It might be configured if necessary. The collected data can be transferred to the software »trascue.PIMS« over a XML output where the data can be analysed. Failure probabilities or renovation actions can be managed with these analyses and with parameter studies.

Data gathering is of course a must before performing a technical condition analysis or calculating the failure probability. This might be realized using a directive for data gathering to ensure that the data is correct. For optimization of orientation and display it is also possible to integrate land register data or other backgrounds.
In all the software is a very elaborate solution which focuses on pipeline integrity using already given data.
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This paper will give an overview, so that the reader gets an idea how we realised the idea of a pipeline integrity management system. The paper will not give details on specific elements such as calculations used for the assessment. It is also not possible to give a detailed documentation of the software.

1. Pipeline Integrity Management System
A responsible job for pipeline operators is to ensure that operated pipelines are safe. Due to the aging of pipelines it is necessary to think about pipeline integrity and a suitable management system. These systems enable pipeline operators to design and integrate processes. The following model could be used for this purpose.

Figure1: Pipeline Integrity Management System

Integrity Management allows different departments and people to work on the safety of a pipeline. Costs and efforts can be shared throughout the cycle.
To support this system, GEOMAGIC, a pipeline operator and engineering consultants developed the software trascue.PIMS. The basis for the cycle is data gathering.
2. Data used for the assessment
It starts with collecting relevant data about the pipeline to run an assessment. Data that could be used are for example pipeline attributes, operating data or inspection data shown as follows:

Figure 2: Input data used for the assessment

The leading system in this case is the one where the pipeline operators keep the data. This might be a GIS, but can also be any kind of database. The design focuses on a platform neutral product because naturally the data maintenance differs from one company to the other.

The advantage of using a GIS is that it is cost effective and additional data from other systems can also be connected to the pipeline such as cp data or pressure changes. Plus the geographic background like cadastral data is at hand. Of course it is necessary to keep these data accurate and up to date. There are different ways of achieving an up to date status. This should be practiced naturally inside the companies.

Keeping the input information up to date is also important for the assessment and its interpretation.
When all data, that is needed and desired for an assessment, is gathered, the software will collect this data. In the next step dynamic segments will be generated. These may differ in length. The software will calculate the length of the segments using specific pipeline properties. This is realised with an XML-output, which basically connects the database or GIS to the assessment software, trascue.PIMS.

There are several ways to run an assessment on these segments.
One option is a ranking. The principle behind the ranking is to grade the pipeline according to its condition. Attributes which influence the grading can be determined beforehand.

Another option for the assessment is using formulas that are defined by the department or the company. The software was designed this way, so that the companies can have an influence.

The third possibility for the assessment is to use probabilistic procedures. Additional statistics are used for the assessment which in the end leads to the conclusion that the integrity of a pipeline is given or not given.

3. Presentation of results
So far there has been no connection between the results or diagrams and the context of geography. This has been made possible with trascue.PIMS. It is possible to show the diagrams of the results plus the geography like cadastral data. If this is existent it should be included to support the view. The segments might be coloured thematically, so that the user is able to identify quickly the relevance of the shown data. Additionally the geographic context makes it easier to compare results. The diagrams make it easy to identify very high or very low value inside the assessment.

Figure 3: Screenshot showing assessment results

The effect of assessment is that subsequent processes can be developed and maintained.
4. Tracking the measures
The software enables companies to plan and control measures for renewals and constructions. This knowledge can be used to interpret the assessment results. The results are displayed together with the measures. Very high failure probabilities can be put into perspective in this case. In this case data must be kept up-to-date as good as possible.

It is important to know which measures were planned but not in action. It is also important to know measures that were already implemented, but not refreshed in the documentation. This knowledge helps to interpret the assessment results.

There are several possibilities to keep the data up to date and to share the work between departments. A mobile system, for example, can be used to reduce the effort because the data input is handled in the field.